

# How can adrenaline help you lift a 3,500-pound car?

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**Bodily Feats Pictures** Can adrenaline explain why a person could lift a car like Bubba Smith as Lt. Moses Hightower in the comedy "Police Academy"? See more bodily feats pictures.

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In 2006 in Tucson, Ariz., Tim Boyle watched as a Chevrolet Camaro hit 18-year-old Kyle Holtrust. The car pinned Holtrust, still alive, underneath. Boyle ran to the scene of the accident and lifted the Camaro off the teenager, while the driver of the car pulled him to safety.

In 1982, in Lawrenceville, Ga., Angela Cavallo lifted a 1964 Chevrolet Impala from her son, Tony, after it fell off the jacks that had held it up while he worked underneath the car. Mrs. Cavallo lifted the car high enough and long enough for two neighbors to replace the jacks and pull Tony from beneath the car.

Marie "Bootsy" Payton was cutting her lawn in High Island, Texas, when her riding mower got away from her. Payton's young granddaughter, Evie, tried to stop the mower, but was knocked underneath the still-running machine. Payton reached the mower and easily tossed it off her granddaughter, limiting Evie's injuries to four severed toes. Curious, Payton later tried to lift the mower again and found she couldn't move it.

What accounts for feats of superhuman strength like these? Are they glimpses into the lives of superheroes' alter egos? Or are all of us imbued with amazing strength?

Although well-documented when they do occur, feats of **hysterical strength** -- unnatural and amazing strength tapped during high-stress situations -- are not recognized by medical science. This is largely due to the problem of gathering evidence: Instances like these come about without warning, and to reproduce these situations in a clinical setting would be unethical and dangerous.

But we are aware of the effects of adrenaline, a hormone shown to increase strength to amazing degrees for short periods of time. Read the next page to find out about adrenaline and strength.

## Woman vs. Polar Bear

Adrenaline doesn't just help people lift cars. In Ivujivik, Quebec, in 2006, Lydia Angyiou wrestled a large polar bear that she saw advancing toward her son and another boy while they played hockey. Angyiou tackled the polar bear and fought it while the boys ran for help. While Angyiou suffered some wounds, the polar bear ultimately lost the fight. Angyiou sparred with it long enough that a neighbor was able to shoot the bear four times until it died.

# Adrenaline and Strength

When we feel fear or are faced with a sudden dangerous situation, the human body undergoes an amazing change. The **stressor** -- for example, the sight of your son pinned beneath a car -- stimulates the **hypothalamus**.

This region of the brain is responsible for maintaining the balance between stress and relaxation in your body. When it's alerted to danger, it sends out a chemical signal to your **adrenal glands**, activating the **sympathetic system**, which sends the body into an excited state. These glands release **adrenaline** (epinephrine) and **noradrenaline** (norepinephrine), hormones that create the state of readiness that helps a human confront danger. Together, these hormones raise heart rate, increase respiration, dilate the pupils, slow down digestion and -- perhaps most importantly -- allow muscles to contract.

All of these changes in our normal physical state prepare us to face danger head-on. Combined, they make us more agile, allow us to take in more information and help us use more energy. But adrenaline's effect on muscles accounts for amazing strength. Adrenaline acts on muscles, allowing them to contract more than they can when the body is in a calm or neutral state.

When adrenaline is released by the **adrenal medulla** -- an interior region of the adrenal glands, which are located just above your kidneys -- it allows blood to flow more easily to your muscles. This means that more oxygen is carried to your muscles by the extra blood, which allows your muscles to function at elevated levels. Skeletal muscles -- those attached to bones by tendons -- are activated by electrical impulses from the nervous system. When they're stimulated, muscles contract, meaning they shorten and tighten. This is what happens when you lift an object, run or throw a punch. Adrenaline also facilitates the conversion of the body's fuel source (glycogen) into its fuel (glucose). This carbohydrate gives energy to muscles, and a sudden burst of glucose also allows muscles to strengthen further.

So does this mean that we have superhuman strength that is unlocked when we're confronted with danger? That's one way to put it.

Some theorize that we normally use only a small percentage of our muscles' capabilities. When we are confronted with danger, we transcend the limitations of our muscles and simply act. The rush of adrenaline, which accounts for a sudden increase in strength, helps to facilitate a person lifting a car. In other words, when confronted with extreme stress, we

involuntarily use our muscles beyond the limitations of their normal voluntary use.

This theory is supported by what happens when a person is electrocuted. Someone who is shocked can be thrown a notable distance from where the shock took place. But this is not due to the electric shock. Instead, it's a sudden and violent contraction of the person's muscles as a result of the electrical charge flowing through the body. This demonstrates a potential for muscle contraction that isn't utilized under normal circumstances. In much the same way that people can't throw themselves across the room, they also can't normally lift a car -- the resources aren't available without the threat.

But why don't we possess superhuman strength all the time? Wouldn't it be beneficial? Read the next page to find out why it's better that we only have bursts of strength.

## **How strong are you?**

You'll be amazed to learn how much force your body's joints and muscles actually support on a daily basis. This interactive segment from Discovery Channel takes you inside the body and explains how much strength your bones and muscles really possess.

## **Why Calm is Better**



Developing muscle strength takes deliberate training; a sudden burst of muscle use can result in injury. Above, Chile's Cristian Escalante lifts 180 kg (almost 400 pounds) to set a record at the 2007 Pan American Games in Brazil.

MARTIN BERNETTI/AFP/GETTY IMAGES

So why do we only possess strength in short bursts when confronted with danger? Why don't we walk around in a constant heightened state of agitation? The short answer is, it would kill us. Here's the long answer.

Turning potential muscle strength into actual muscle strength takes deliberate training. Muscles strengthen over time through use, as in lifting weights. While our muscles may possess potential strength that can be tapped when faced with danger, this can also have dangerous repercussions. Muscles suddenly used beyond their capacity can tear, and joints can be pulled out of their sockets.

The physical state of agitation, too, can cause lasting negative effects beyond immediate injury. Austrian physician Hans Selye studied the human reaction to stress and concluded there are three stages that make up what he termed **general adaptation syndrome**. The first stage occurs when you encounter stress, the **alarm reaction** (AR) stage. This stage includes the arousal of your **fight-or-flight** response to a stressor. All of your internal alarms are activated and you prepare to face danger or run away. The next stage is the **stage of resistance** (SR). In the SR stage, the human response to danger is in full swing: Your pupils dilate, your heart rate and respiration go up and your muscles contract. At this point you are running for your life, lifting a car off another person or engaged in another above-average activity.

In the case of seeing a person pinned beneath a car, the stressor is short-lived. The body begins to relax and returns to its normal state after a few tense minutes. After the stressor is gone, the **parasympathetic system** kicks in. This system plays a role opposite of the sympathetic system. When the parasympathetic system takes over, heart rate slows again, breathing returns to normal, muscles relax and nonessential functions (like digestion) immediately begin again. The hypothalamus, which is responsible for triggering both the sympathetic response in the

face of danger and the parasympathetic response after the danger has passed, is ultimately responsible for achieving a balance between both. This balance, the body's normal state, is called **homeostasis**.

When the body stays in an excited state for a prolonged period, it enters the final state of Selye's general adaptation syndrome -- the **state of exhaustion** (SE). This stage occurs when response to a stressor has gone on too long. In this state of hyperarousal, the body's immune system begins to wear down. As a result, a person will be more susceptible to infections and other illnesses as the body's defenses have been spent on dealing with a stressor. A person in a prolonged state of stress may easily catch a cold or have an increased chance of suffering a heart attack. The state of exhaustion stage is seen most frequently in cases of prolonged stress, such as workplace stress.

So ultimately it's a good thing your body's goal is homeostasis. If we existed in an excited state all the time, we would run out of gas.

For more information on the human body, read the next page.

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